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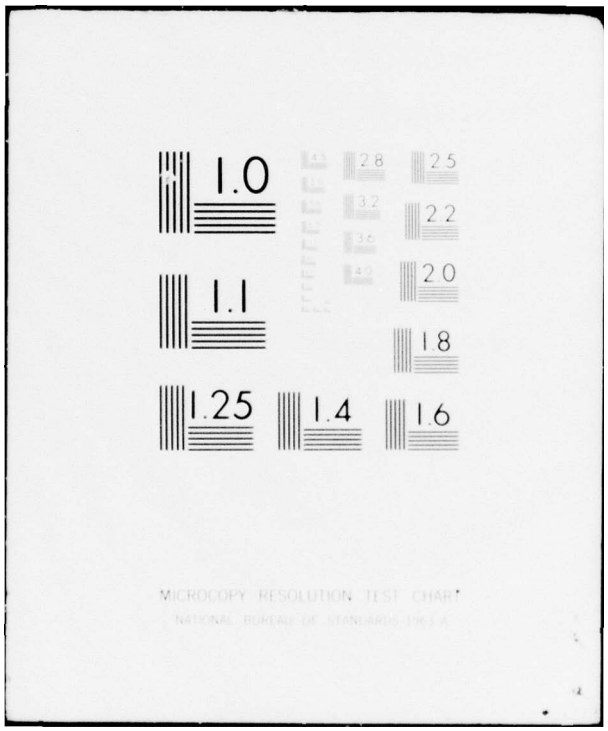
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OFFICE OF NAVAL RESEARCH

LONDON

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M. E. Bell

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PENETRATING PAIRS PRODUCED BY COSMIC RAYS UNDERGROUND

Recent experiments with Geiger counters by Amaldi, Castagnoli, Gigli, and Sciuti of the Institute of Physics of the University of Rome has indicated a much lower cross section for the production of penetrating pairs underground than previous similar work (George and Trent, Nature 164, 838 (1949)); Braddick, Nash, and Wolfendale, Phil. Mag. 42, 1277 (1951)).

The new experiments were concerned with the production of a single penetrating secondary by a μ-meson in a block of lead. The cross section for this process was found to be 6×10^{-30} cm^2 for secondary particles capable of penetrating 5 cm of lead and 2×10^{-30} cm^2 for those capable of penetrating 15 cm of lead.

The measurements were carried out by Professor Amaldi and collaborators at a depth of forty meters water-equivalent below sea level by means of a large Geiger counter telescope and a hodoscope arrangement. The telescope consisted of four trays of counters designated B, C, D, and E respectively and separated from each other by vertical distances of the order of 50 cm. The effective area of each tray was about 3.2 square meters giving a large counting rate (about 12.6 particles per minute) and a good angular definition (a few degrees).

The individual counters of trays B,C,D, and E were hodoscoped, i.e., each counter was connected to a corresponding neon lamp, so that when a master coincidence took place, it was possible to establish which of the counters had been hit. For the most part, the master coincidence required a single counter to go off in trays B,D,and E, and two counters in tray C.

Trays C,D, and E were located just below 5 cm thick shields of lead, while about 50 cm above tray B was placed a 5 cm thick lead screen designated Σ. A very large tray of Geiger counters designated as A was located just above Σ.

By making runs with and without Σ it was possible to study the production of secondary particles in Σ, and by means of the hodoscope arrangement the range of the secondary particle could be determined. The analysis of the data obtained in a total recording time of 620 hours gave the cross sections quoted above which are in good agreement with the cross section for nuclear interaction of μ-mesons obtained by George and Evans (Proc. Phys. Soc. 63, 1248 (1950)), and G. Cocconi and V. Cocconi-Tongiorgi (Phys. Rev. 83, 29 (1951)).

SEARCH FOR A NEUTRAL COSMIC-RAY COMPONENT UNDERGROUND

The existence of a neutral component underground has been suggested most recently by Hayakawa (Proc. Phys. Soc. A 65, 215 (1952)) for the purpose of explaining the production of penetrating pairs underground with a cross section of about 5×10^{-29} cm per nucleon as obtained by George and Trent and by Braddick, et al.

The results of Amaldi and collaborators given above make Hayakawa's assumption superfluous. However they were able to use some of their data for an anti-coincidence experiment similar to that suggested by Hayakawa at the end of his paper to determine the conversion of uncharged into charged particle. Tray A is used as the anti-coincidence tray; fourfold coincidences (B C D E) and fivefold coincidences (A B C D E) are then compared with and without lead screen Σ.

From a comparison of these results, it is possible to deduce the cross section for charge exchange within the lead block Σ and compare it with the predicted charge exchange cross section which should be of the order of 100 times the value of the cross section for pair production (since charge exchange is a first order and pair production is a third order process). The number of neutral particles which convert in the lead block is found to be much too small, however, (by about a factor of 100) to be in agreement with Hayakawa's hypothesis.

THE OPTICAL PROPERTIES OF CRYSTALLINE GERMANIUM

Brattain and Briggs (Phys. Rev. 75, 1705 (1949)) have measured the optical properties of germanium thin films. They observed in their paper that the index of refraction of the films studied was about 10 per cent lower than that found for prisms and suggested that this was due to a lower density in the thin, amorphous films. H.A. Gebbie of the Services Electronics Research Laboratories, Baldock, Herts, has recently performed a series of experiments which clarify this situation.

Mr. Gebbie has found that if evaporated films of germanium are annealed for one hour at 600°C, a substantially crystalline material results with a distinct modification in both transmission and index of refraction. In recent measurements on samples about 770A thick (as determined by multiple beam interferometry), the cutoff (T = 10 per cent) moved from 0.76 microns in the amorphous state to 0.70 microns in the crystalline state. Wavelengths shorter than this are absorbed.

At the same time, the low order interference bands found in the transmission characteristic move to shorter wavelengths indicating an increase in the optical thickness of about 10 per cent. The physical thickness of the films is substantially unchanged, and therefore the index of refraction may be assumed to have increased, and to be in substantial agreement with the bulk value. Very large changes in the electrical resistance of the films are also observed.

FARADAY SOCIETY DISCUSSION ON RADIATION CHEMISTRY

At the Faraday Society Discussion on Radiation Chemistry which took place recently in Leeds, the discussions revealed that most of the basic techniques and fundamental standards of radiation chemistry still need final definition. The contributions of Professor Bacq (Liége) and Dr. Dale (Manchester) dealing with the protective effect of amines and with the general problem of protection in multi-solute systems are of far-reaching potential importance. These are discussed in the Biological Sciences section of this issue.

The complete Proceedings of the Discussion will be published by the Faraday Society in about six months. Technical Report ONRL-48-52, summarizing some of the papers and discussions, is forthcoming and will be available from the Technical Information Division, Code 250, Office of Naval Research, Washington 25, D.C.

Actinometry and Dosimetry

The recognition of the advantages of chemical vs. ionization methods of dosimetry, especially in the case of inhomogeneous radiations, has revived interest in the chemical procedures. In addition, the chemical methods are generally faster and more convenient. No general agreement has been reached as yet, however, on the best standard procedures. In aqueous systems the sulfuric acid solution of ferrous sulfate is generally accepted as most suitable, at least for dose rates not exceeding 1000 roentgen/min/g. of solution. Above this dose rate the yield begins to decrease, but the details of this change in yield have not yet been quantitatively elucidated. The aftereffect in this system is negligible after ten minutes, but it should be kept in mind during this period as it may lead to erroneous results. At high dose rates the ceric sulfate system (again in 0.8N sulfuric acid solution) is probably superior to the ferrous sulfate system. J.J. Hardwich (Chalk River, Canada) reported on experiments with this system at dose rates up to about 36,000 r/min/g. of solution. All surfaces in contact with the irradiated surface must be extremely clean. The yield varies inversely as the energy of the irradiating electrons.

Quantum Emission from Irradiated Liquids

The interesting paper published by P.I. Dee and E.W.T. Richards (Glasgow) (Nature 168, 736, (1951)) was discussed by several speakers and it appears that the observations are not readily reproducible and may be incorrect. Dr. Richards presented further results at this meeting in which light emission was again observed during a α-particle bombardment, but no estimate of the energy balance was given. Dr. N. Miller (Edingurgh) has failed to reproduce these results in a series of elaborate experiments; neither the reported chemical effects nor light emission was seen.

Determination on the Number of Free Radicals in Liquids

The stable free radical α-diphenyl β-picrylhydrazyl (DPPH) is being used in several laboratories to estimate quantitatively the number of free radicals produced in liquids. M. Magat and his collaborators (Paris) reported a detailed comparison of the DPPH method with that based on

the well known fact that free radicals initiate polymerization. When carefully used, the two methods give reasonably consistent results for most of the organic liquids studied. (cf. ESN 5, 300 (1951)) The DPPH method is fast and convenient but has several limitations, the chief one being the reactivity of DPPH with double bonds, with water, and with organic hydroxyl groups and other labile hydrogen atoms. This hazard was also emphasized by Professor C.E.H. Bawn (Liverpool) who pointed out the great danger of falsifying the results because of minute traces of impurities containing labile hydrogen.

Decomposition of Water by Ionizing Radiations

As would be expected, consideration of the mechanism of the decomposition of water by ionizing radiations led to a lively and inconclusive discussion. A.O. Allen (Brookhaven) reviewed a great body of work done at various AEC laboratories in the U.S. He favors the view that the initial hydrogen yields at low dose rates do not depend on the composition of the solution. His reaction mechanism involves the simultaneous decomposition of water to molecular hydrogen and oxygen and to free hydrogen atoms and hydroxyl radicals.

M. Haissinsky (Paris) reviewed arguments previously put forward, to justify the hypothesis that molecular hydrogen in the radiochemical transformations in water is formed mostly through an elementary process of the type: $H_2O + e \longrightarrow H_2 + O^-$ (cf. ESN, 5, 298 (1951)). Magat presented some semi-quantitative theoretical arguments to indicate that this reaction is about as favorable as the more conventionally accepted one yielding a hydrogen atom and a hydroxyl radical. His considerations involve the approach of an electron to a water molecule perpendicular to the imaginary H---H line putting it in a position where the formation of a H-H bond is sterically favored. The experimental results presented by P. Bonet-Maury (Paris) do not favor the above mechanism, however, as the quantity of hydrogen gas formed is too low. A.G. Maddock (Cambridge) suggested that the reaction $H_2O \rightsquigarrow 2H+O$ may be an important one in cases where low hydrogen yield is observed.

Formation and Decomposition of Hydrogen Peroxide

While the photochemical decomposition of hydrogen peroxide yields hydroxyl radicals and eventually water and oxygen, small amounts of hydrogen are also formed when H_2O_2

is decomposed by ionizing radiations.

The mechanism and kinetics of the gamma ray induced decomposition proposed by E.J. Hart (Argonne Laboratories) were disputed by several speakers. Hart reported on a large number of experiments using Co^{60} as the gamma source, dosage rates of (0.004 to 0.63) X 10^{20} e.v. absorbed/L.min., H_2O_2 concentrations of 0.008 to 200 millimolar. The decomposition varied as the square root of H_2O_2 concentration and the inverse square root of the dosage rate. The termolecular reaction:

$$2HO_2 + H_2O_2 = 2H_2O_2 + O_2$$

was proposed as the termination step.

Recent experiments of Dainton (Leeds) contradict these conclusions and indicate that the decomposition of H_2O_2 depends on the first power of its concentration.

OXIDATION OF IRON

J.A. Bardolle and J. Benard of the Laboratoire de Chimie Appliquée, Université de Paris, are studying the mechanism of the oxidation of iron. Their experiments have shown the nature of nucleation and growth of the oxide and its orientation.

Metallographic examination of iron specimens exposed to air at 10^{-2} to 10^{-3} mm pressure for 9 hours at a temperature of 850°C showed the existence of oxide nuclei of crystalline form rather than a general layer. The size and number of nuclei vary with the orientation of the iron grains, and the fewer the nuclei the larger the size for a given treatment. It was also seen that there is an orientation relationship between the oxide microcrystals and the metal, which is now being determined by X-ray diffraction.

Similar experiments at the same temperature, but at slightly higher pressures (0.1 mm) have also been conducted. In one hour many nuclei are formed and in nine hours the oxide forms a complete layer with a serrated surface. The thickness of the layer depends upon the orientation of the metal grain and Laue back reflection pictures show that the oxide grains have fiber axes.

On the other hand, at 0.1 mm and 750°C, the oxide surface is smooth and continuous rather than serrated. X-ray diffraction study has shown that in this case single crystals of oxide exist on each of the metal grains. The grain boundaries of the oxide coincide with the grain boundaries of the metal provided there is no displacement of the latter during oxidation. Considerable work has been done on the development of a special technique of specimen preparation to prevent grain boundary migration and obtain a suitable initial surface. This technique involves mechanical and electrolytic polishing, hydrogen treatment, and finally vacuum annealing. The investigators are preparing papers on this technique as well as their results on the oxidation of iron for publication in the Revue de Metallurgie.

GRAIN BOUNDARIES

Dr. P. Lacombe of the Laboratoire de Chimie Appliquée, Université de Paris, is conducting an investigation to determine whether the nature of grain boundaries differs in recrystallized and as-solidified metal. Preliminary results on 99.99 per cent aluminum with a technique capable of detecting small differences in grain boundary energy have shown no difference.

A plate specimen of coarse grained, recrystallized aluminum was heated at one end so that half of the specimen was melted. Under controlled solidification, columnar crystals formed which were nucleated by the unmelted grains at the solid-liquid interface. The entire specimen consisting of recrystallized and "as-cast" grains was subjected to an etchant which preferentially attacked the grain boundaries. The extent of intergranular attack was the same in the recrystallized and as-solidified portions, which indicates qualitatively that the grain boundaries do not differ in the two structures. The technique used is quite sensitive to differences in grain boundary energy. Lacombe has previously shown the difference in the amount of grain boundary attack depending upon the relative Orientations of the crystals (Compte Rendus, 226, 498 (1948)).

NODULAR IRON

One of the problems in producing nodular cast iron is that the agent added to the melt is not always successful in producing graphite nodules. Present practice

is to put the additive in a sealed iron box which sinks to the bottom of the melt and thus allows the mixing to take place deep within the bath where loss will be minimized. The mechanism of the nucleation of nodules is not well understood and in a typical commercial plant successful castings are produced only about half the time. M. Eudier of the Laboratoire des Poudres, Beauchamp, France, has developed a technique which thus far has succeeded in every trial in producing nodular iron.

Eudier has used powder briquets consisting of 90 per cent iron and 10 per cent of the magnesium- calcium eutectic. The addition is made in the ladle where the briquet sinks and since the agent is intimately mixed with iron powder, solution occurs at a controlled rate with good efficiency.

ITALIAN RESEARCH ON NON-LINEAR DIFFERENTIAL EQUATIONS

Work on non-linear problems in the theory of differential and related functional equations is currently being done at the Universtities of Pavia, Florence, and Bologna, as well as the Politecnico di Milano. While at Pavia the subject happens to be a personal interest of one of the mathematicians on the faculty, it constitutes a systematically fostered research activity in the mathematics departments of the other three institutions. This development is noteworthy because the traditionally intensive preoccupation of Italian mathematics with classical infinitesimal analysis provides a fertile ground for the growth of research activities on problems in the more recent theory of non-linear phenomena.

University of Bologna

Research on non-linear differential equations is carried on at the Mathematics Institute under Professor D. Graffi whose principal interests lie in the field of theoretical electronics where he was originally led to the consideration of such problems. One of these problems concerns the oscillations of electric circuits which contain non-linear elements. Following up earlier work on a single such circuit, Professor Graffi is now investigating coupled systems obeying equations of the form

$$L_1 i_1'' + M i_2'' + G_1(i_1)\, i_1' + \frac{1}{C_1} f_1(i_1, i_2) = 0,$$

$$L_2 i_2'' + M i_1'' + G_2(i_2)\, i_2' + \frac{1}{C_2} f_2(i_1, i_2) = 0.$$

Bounds are sought on the frequencies of the possible joint oscillations of these circuits in terms of the frequencies at which the linear system, $f_1(i_1,i_2) \equiv i_1$, $f_2(i_1,i_2) \equiv i_2$ and $G_1 \equiv G_2 \equiv 0$, will oscillate. The method employed for this purpose consists essentially in averaging the sum of i_1 times the first plus i_2 times the second equation over a period, and introducing Fourier developments for the unknown functions into estimates derived from the resulting relation. Work presented to the Non-Linear Oscillations Symposium at Porquerolle last September for the case $f_1(i_1,i_2) \equiv i_1, f_2(i_1,i_2) \equiv i_2$ (see Technical Report CNRL-128-51) has since been extended to a more general class of functions f_1 and f_2.

Another novel technique, relating to uniqueness proofs, has its origin in studies concerning the theory of systems exhibiting "hereditary" phenomena in the sense that their behavior depends not only on the present state of the determining quantities but also on their past history. A number of characteristic examples were examined where the governing equations turn out to be linear ones of integro-differential type, and it was found that the uniqueness of a solution for appropriate initial (and boundary) conditions could be established by proving a relation of the form

$$A\left[S_1 - S_2\right] = c.\int_0^t A\left[S_1 - S_2\right] d\tau$$

for an expression $A[S]$ which is never negative and vanishes if and only if the quantity S on which it depends does the same. The competing solutions have been denoted by S_1 and S_2 so that initially $A[S_1 - S_2] = 0$. It suffices to ascertain the validity of such a relation for all $0 < t \leq T$ where c may now depend on T. Successive repetition of the argument for the intervals $nT < t \leq (n+1)T$, $(n = 0,1,\ldots)$ will then complete the uniqueness proof.

This last point has enabled Graffi to establish by this method the uniqueness of the solution for a modified form of the three dimensional flow equations for a perfect compressible fluid if the flow is prescribed initially and its normal velocity component is to vanish at all times on the boundary of the flow region, assumed to be finite. The modification consists in dropping from the continuity equation, $\rho_t + \vec{u}.\text{grad}\,\rho + \rho\,\text{div}\,\vec{u} = 0$, the term $u \cdot \text{grad}\,\rho$ (ρ = density, $\vec{u}$ = velocity vector).

Physically this amounts to ascribing near-incompressibility to the individual fluid particles, local variations in density being essentially due to the successive arrival of particles of different densities;--thus the occurrence of shock waves is, of course, avoided.

The same procedure has recently been applied successfully by Dr. R. Nardini, Professor Graffi's assistant, to the hydro-magnetodynamic equations of Alfven where $\vec{u}$ and $\vec{H}$, the magnetic field vector, are given initially while the normal component of $\vec{u}$ as well as the tangential component of $\vec{H}$ vanish at all times on the boundaries. It was possible in this case to estimate the space integrals of the squared magnitudes of these two vectors by linear combinations of the corresponding time integrals.

Also in connection with existence problems the study of hereditary phenomena has suggested a procedure which can be traced back to an idea of Tonnelli's on the solution of functional equations and which has recently been extended by Nardini to a type of equation where a Fredholm integral transform is supplemented by a sufficiently regular but non-linear functional of the unknowns. Although not differential equations themselves, they are of a type which might be encountered, e.g., in the theory of elastic bodies exhibiting hysteresis effects, if the governing relations are cast into integral form. The solution is constructed by an approximation process containing the elements of both an iteration procedure and a stepwise integration. With the range of the independent variable over which the solution is to be defined divided into a large number of small subintervals, the n^{th} approximation is obtained by iteration from the $(n-1)^{st}$ approximation on the segment consisting of the (n-1) first subintervals. At the same time it constitutes a first approximation on the n^{th} subinterval, while its relation to the solution on all later subintervals cannot be ascertained. With increasingly fine subdivisions the accuracy of approximation can thus be driven to any desired size. No application of this technique to higher-dimensional domains has been made as yet.

University of Florence

The Mathematics Institute at Florence is under the direction of Professor G. Sansone, well known as expert in the field of ordinary differential equations. Stimulated by Graffi's earlier work on the existence and

and the determination of periodic solutions for equations of the form

$$x'' + c\, f(x)\, x' + c^2\, g(x) = 0$$

he has attacked this problem for the case $g(x) \equiv x$ from the following viewpoint: First he proves that if he has two equations of this type, differing only with regard to the functions $f(x)$ appearing in the damping term and possessing each a single periodic solution, then $f_1(x) \equiv f_2(x)$ implies for the corresponding closed trajectories in the (x,x') plane that the first does not penetrate the interior of the domain bounded by the second. This fact is followed by the derivation of reasonably general sufficient conditions for step functions $f(x)$ which insure the existence of at least one periodic solution of the corresponding differential equation, supplemented by additional ones which insure uniqueness of this solution. This, in turn, sets the stage for proving the existence, and providing a method for the approximate determination of periodic solutions in all those cases where $f(x)$ can be approximated from above and below by step functions satisfying these conditions.

The question of extending these results to equations with general restoring term $g(x)$ is now being attacked along two independent lines The first of these consists in a systematic study of the so-called "stroboscopic method" proposed by Minorsky in connection with specific examples, with the aim of giving it a rigorously general foundation. This method, in essence, locates periodic solutions by dissolving each trajectory in the phase plane into a sequence of points corresponding to equidistant epochs of the independent variable and using these point sequences to construct a new system of trajectories which represent simply a smoothed version of the polygonal arcs consisting of the line segments connecting successive points. The main idea is that of deriving the system of differential equations, satisfied by these new trajectories, without ever actually constructing the original ones. Every original solution with the given increment as period is now marked by a singularity of the new system and its stability character by the type of the latter. This method is being followed up by Mr. O. Castro of the University of Madrid, currently working as Professor Sansone's assistant at Florence.

The second approach is in the hands of Dr. R. Conti who is investigating the implications in this context of a recent Russian paper giving sufficient conditions for the existence of periodic solutions in terms of the behavior of f(x) when considered as function of the variables

$$z_1 = \int_0^x g(\xi)\, d\xi \quad \text{for } x > 0,$$

$$z_2 = \int_0^x g(\xi)\, d\xi \quad \text{for } x < 0.$$

Another study of Conti's concern second order partial differential equations in two independent variables of mixed type, especially the problem of existence and uniqueness of the solutions when the initial data are given along the curve separating hyperbolic from elliptic regions (parabolic curve). Non-linearities in the differential equation are permitted provided they do not affect the highest order derivatives or their coefficients. If this parabolic curve possesses a double point with distinct tangents, then the evident smoothness conditions, together with the requirement that the solution is to vanish at that double point in sufficiently high order, were found sufficient to guarantee existence and uniqueness of the solution. In the simpler case of a parabolic curve which has but a single branch, similar investigations led to a proof of the fact that the stream function of a perfect compressible flow is uniquely determined in the hodograph plane by its values on the sonic circle (Ann. mat. pura ed appl. 32, 235-248 (1951)).

Politecnico di Milano

Research on non-linear problems is being conducted by Professor L. Amerio who is following up previously reported investigations (ESN 5, 292 (1951)) on the local structure of the manifold of solutions in phase-time space. Dealing in particular with the forced oscillations of a pendulum

$$x'' + \lambda x' + \sin x = \phi(t)$$

he has succeeded in characterizing the surface in (x,x',t)-space which separates bounded from unbounded solutions, -- the latter corresponding to cases where the pendulum ultimately goes over the top. This surface is a locus of periodic solutions having saddle-point like instability in the sense that through them there pass exactly two distinct periodic integral surfaces of the partial differential equation which has the phase trajectories of the pendulum equation as characteristics. In other cases where time does not occur explicitly in the equations, a stable limit cycle in the phase plane gives rise in (x,x',t)-space to a right cylinder with generators parallel to the time axis through this cycle. Trajectories which in the phase plane approach the limit cycle will if represented in (x,x',t)- space appear to wind themselves asymptotically onto this cylinder, and Amerio has determined the surface generated by all those which ultimately approach a given one of the trajectories on the cylinder.

Professor Amerio's assistant, Dr. Giovanni Prodi, has studied the solutions of

$$u_{xx} = u_t + f(x,t,u,u_x)$$

in the half-strip $0 \leqq x \leqq 1$, $0 \leqq t$, with given $u(0,t) = \phi_1(t)$, $u(1,t) = \phi_2(t)$. Under reasonably general smoothness conditions he has shown that this problem has a solution which is periodic in t, provided that f as a function of t, as well as ϕ_1 and ϕ_2, are themselves periodic with the same period. A similar theorem holds if the property of being periodic with given period is replaced by almost periodicity. The proof for the existence of such solutions is based on the Schauder-Leray method and therefore non-constructive. Future work will concern itself on the one hand with the asymptotic approach of a solution with given initial distribution, $u(x,0) = g(x)$ for $0 \leqq x \leqq 1$, towards periodic behavior and on the other hand with the extension of these results to several space dimensions. Preparatory to this latter attempt, Amerio himself is studying the linear diffusion equation in several spatial variables for initial domains having corners on their

boundaries. The aim of this investigation is to ascertain the behavior of the higher derivatives of the solution in the neighborhood of the time-parallel lines through these corners. Particular attention is being given to cases where the boundary conditions are of mixed type, the solution itself being prescribed on some, its normal derivative on other faces of the boundary.

University of Pavia

Here Professor Maria Cinquini Cibrario is continuing her study of the general theory of characteristics for non-linear partial differential equations of hyperbolic type in two independent variables. In earlier papers she has anticipated some of the results obtained by R. Courant and P. Lax (Communications on Pure and Applied Mathematics 2, 275-292 (1949)) in their treatment of the Cauchy problem for quasi-linear systems of this type. In the meantime Professor Ciquini Cibrario has extended her investigations to problems of the Goursat type, where the solution is required to contain a given characteristic strip and to satisfy on an intersecting, non-characteristic curve a subsidiary linear relation.

This generalization was first carried through for cases equivalent to a hyperbolic system of first order quasilinear equations where the subsidiary condition, satisfied along the additional curve, is a linear relation between the dependent variables, the coefficients being functions of the independent ones (Ann. Scoula Norm. Sup. di Pisa, Ser. III, 3, 161-197 (1949)). Quite recently existence and uniqueness of the solution have been established by her in the case of a single non-linear equation of arbitrary order and hyperbolic type

$$F(x,y,p_{r,s}) = 0,$$

where $$p_{r,s} = \partial^{r+s}z/\partial^r x\,\partial^s y,\quad 0 \leqq r+s \leqq n$$

and $$P_n\rho^n - P_{n-1}\rho^{n-1} + \ldots + (-1)^n P_o = 0$$

$$P_i = \partial F/\partial p_{i,n-i},\quad i = 0, 1, \ldots, n$$

has real distinct roots throughout the range on which the P_i have to be considered. The integral is required to pass through a given characteristic strip and satisfy on the other curve a linear relation in its derivatives up to order n.

PROTECTIVE ACTION OF AMINES

At the Faraday Society Discussion on Radiation Chemistry, summarized on page 126 of this issue, Professor Z.M. Bacq (Liége) reported on some recent experiments on protection against ionizing radiation. He has found that many aliphatic and aromatic amines have a large protective action against radiations but the best compound tested thus far is $HS-CH_2-CH_2-NH_2$. Three milligrams of this compound injected into mice enabled 97 out of 100 mice to survive irradiations of normally lethal doses of 700 roentgens. In another laboratory all six exposed mice were able to survive exposure to 950 roentgens. Preliminary experiments with a similar compound, $H_2N-CH_2-CH_2-S-S-CH_2-NH_2$, indicate that its protective action might be even better than the above.

Both of these compounds are non-toxic and would be suitable for human use according to Professor Bacq. However, in order for them to be effective they must be injected prior to exposure since both are entirely inactive if injected after irradiation. It was suggested by Professor Bacq that a possible mechanism for the protective action of these compounds might be the deactivation of the free radicals produced in the body by the radiations.

BRAIN WAVES IN MENINGO-ENCEPHALITIS

At the Faculty of Medicine, University of Montpellier, Dr. Pierre Passouant is making an intensive study of changes that occur in brain waves in cases of tubercular meningo-encephalitis, by comparing the electroencephalographic traces recorded in the waking state and during the sleep of the patient. It is well known that the EEG traces during spontaneous sleep in a normal subject are characterized by three successive stages: (1) progressive reduction of alpha waves; (2) the appearance of "spindles" at intervals of 14 cps; (3) the onset of delta waves. In cases of tubercular meningo-encephalitis, this pattern is greatly altered. Prior to sleep the EEG traces are slow, diffuse waves similar to those recorded from a normal subject during deep sleep. While the patient is falling asleep, gaps appear between the wave trains, and in deep sleep surges of 5 to 6 cps interrupt the delta and sub-delta rhythms. These modifications of the EEG traces prognosticate death within a month in 90 per cent of the cases. In those cases which improve under the administration of streptomycin, the normal pattern during sleep gradually reappears.

FORTHCOMING EVENTS

The Third International Spectroscopy Colloquium will be held in London, Sept. 1 - 3, 1952. The Colloquium is sponsored jointly by the Institute of Physics and the Industrial Spectroscopy Group. Sessions will be held on spectroscopic light sources, emission spectroscopy, ruling of diffraction gratings, and absorption spectroscopy.

Further information and enrollment forms may be obtained from Mr. E. van Someren, 47 Belgrave Square, London, S.W. 1

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